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Protecting Gorgonian Corals off Alaska from Fishing Impacts

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Abstract -- Large deep sea corals of the Order Gorgonacea are found in the North Pacific Ocean off Alaska, USA. The North Pacific Fishery Management Council has identified these corals as essential fish habitat of particular concern, so management measures to reduce the fishery impacts are being considered. These corals have been shown to be 1) important shelter for rockfish and other fish species; 2) very long lived; 3) easily damaged by fishing gear; and 4) slow to recover from damage. Coral conservation measures previously implemented include trawl closure areas and a prohibition on commercial harvests. Because other fishing gears (e.g., longlines and pots) also impact corals, a prohibition of all gear types in areas of high coral concentration was proposed and evaluated. The proposal was tabled because available scientific data on coral distribution was at too large of a scale to define discrete locations of coral colonies. Additionally, many fishermen using longline and pot gear were concerned about being displaced from areas they had previously fished, and many felt that their gear caused less damage to corals than trawl gear. Involvement of stakeholders at the local level will allow for better information exchange, including information on coral distribution, fishing gear impacts, and development of appropriate management measures.

Introduction

It is not widely known that corals commonly occur in the cold waters off the Alaska coast of the United States. The focus of national and international legislation designed to protect corals has been on shallow water coral reefs located in tropical areas. Protection of cold water corals has been generally overlooked, yet these corals are no less spectacular from a biological, ecological, and even aesthetic standpoint. Perhaps it is just a case of 'out of sight; out of mind'. The purpose of this paper is to review the need to protect coral from fishing impacts, and to discuss an approach to achieve this objective.

The largest and perhaps most charismatic of the deep sea corals belong to the Order Gorgonacea. Gorgonians are colonies of animals composed of individual polyps which deposit a tree-like skeleton. Common gorgonians off Alaska include red tree coral (*Primnoa willeyi* and *P. resedaeformis*), bubble gum coral (*Paragorgia arborea*), and other sea fans (*Calligorgia* sp.) (Heifetz, 1999). These large corals colonies (up to 3 m high and 7 m wide) are slow growing and may be very long lived (> 500 years) (Risk et al., 1998). The colonies are attached to rocks and generally occur in discrete aggregations (like groves of trees) in deep water (10-800 m) characterized by fairly strong currents (3-4 knots) and low turbidity (Cimberg et al., 1981; Krieger, 1998). When alive, deep sea gorgonian corals are brightly colored and make for breathtaking underwater sights. There are many reasons to protect large deep sea corals, some of which are related to their ecological functioning, and others related to their use by mankind.

Corals create complex habitat by providing shelter, prey, and habitat for fish. Fossa et al. (1999) observed dense aggregations of rockfish (*Sebastes* sp.) on deep water Scleractinian coral (*Lophelia* sp.) off Norway. Longline catches of rockfish and other species were much higher in coral areas than surrounding areas without corals. Other studies in Norway have also shown the importance of deep-water corals in marine ecosystems, in providing habitat and prey for other megafauna species (Mortensen et al., 1995). Krieger (1999) reported that rockfish were associated with *Primnoa* and that starfish were preying on the colonies.

Deep sea corals also have use for medicine and scientific research. Sea fans are known to contain high concentrations of prostoglandins, a 'wonder drug' used to treat heart disease and asthma (Faulkner, 1992). Corals also

contain pseudopterosins (a pain killer) and gorgonians produce antibiotics. Hanfee (2000) reports that tons of gorgonians have been harvested off India and exported worldwide for pharmaceutical uses. Another scientific use of corals is a time record of sea temperatures. Skeletons of *Primnoa* colonies grow directly in relation to water temperature so they can provide a historical record of ocean temperature (Smith et al., 1997). A 5 cm diameter specimen of *Primnoa* was estimated to be about 500 years old, based on isotope dating (Risk et al., 1998). Given that larger specimens have been reported, *Primnoa* colonies may provide temperature data from the last thousand years or more, thus allowing scientists to test hypotheses on climate change and regime shifts.

In the United States, protection of gorgonian corals may be warranted under the Magnuson-Stevens Act (the law that establishes the U.S. national program for conservation and management of fishery resources), as modified by the Sustainable Fisheries Act of 1996. The law requires fishery management councils to minimize, to the extent practicable, adverse effects on essential fish habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat (Fluharty, 2000). Areas of special importance that may require additional protection from adverse effects were designated as habitat areas of particular concern. Habitat areas of partucular concern are defined on the basis of its ecological importance, sensitivity, exposure, and rarity of the habitat. Gorgonian corals epitomize of this type of special habitat.

Where are corals located off Alaska?

Gorgonian corals are widely distributed along the continental shelf and slope along the Gulf of Alaska and the Aleutian Islands. Distribution information was examined using two databases: the National Marine Fisheries Service bottom trawl research surveys, and incidental catch data collected by fishery observers. Gorgonian corals off coastal Alaska were analyzed from the 1954-1998 survey data and plotted by location. Catch per unit effort was calculated by weight of gorgonians (kg) in trawl by the area swept (distance towed * net width) for each tow with coral present. Observer data included any haul containing coral from any species during the period 1991-1998. Unfortunately, there is no taxonomic identification of coral in the observer database, and coral is combined with bryozoans in the records, so this data base has only limited use as supplemental information on distribution.

The relative distribution of Gorgonian coral from survey data is shown in Figure 1. Relative total amounts of gorgonian coral were highest off of Southeast Alaska near the Canadian border, at the western end of the Aleutian Islands, and near the Kenai Peninsula. The highest CPUEs for gorgonians occurred near Attu Island, Kiska Island, Amlia Island, the Kenai Peninsula, Yakutat, and Dixon Entrance.

Relative distribution of coral and bryozoans using observer data of trawl, longline, and pot gear fisheries is shown in Figure 2. The relative longline and pot gear catch of coral (all species) in the Aleutian Islands was highest in the vicinity of Kiska, Attu, and Amchitka Islands. The highest observed catch in trawl fisheries was taken in the Aleutian Islands in the vicinity of Kiska Island and the Pribilof Islands. Analysis of survey data indicated that the Pribilof catch was likely all bryozoans, however (NPFMC 2000). No catch of coral of a similar magnitude was found in trawl catches in the central Gulf of Alaska nor in Southeast Alaska. The only relative catch in fixed gear fisheries of a similar magnitude to that found in the Aleutian Islands was found off Southeast Alaska.

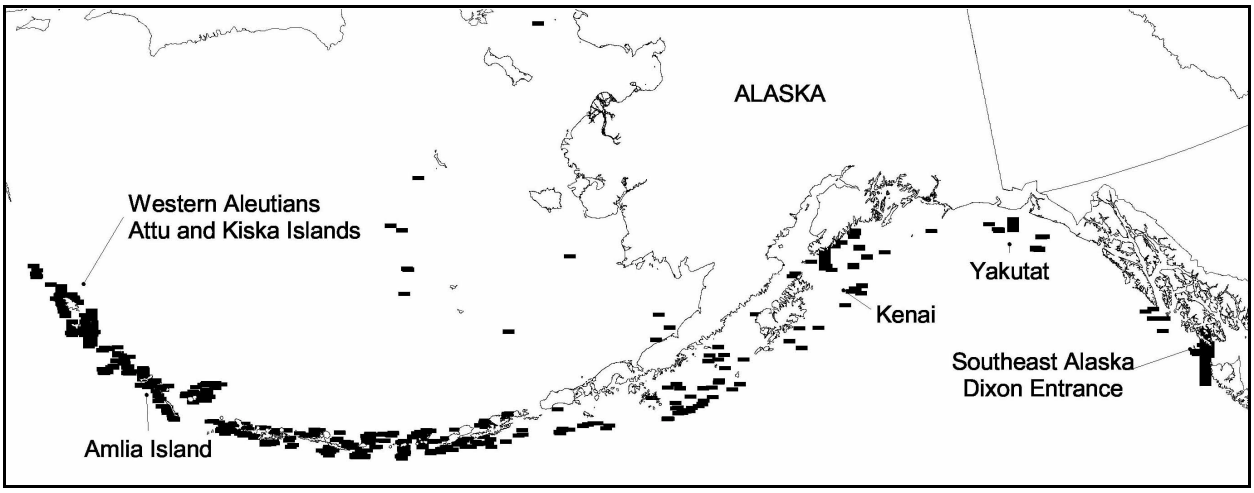

Figure 1. Relative abundance and distribution of gorgonian corals based on trawl survey data, 1954-1998.

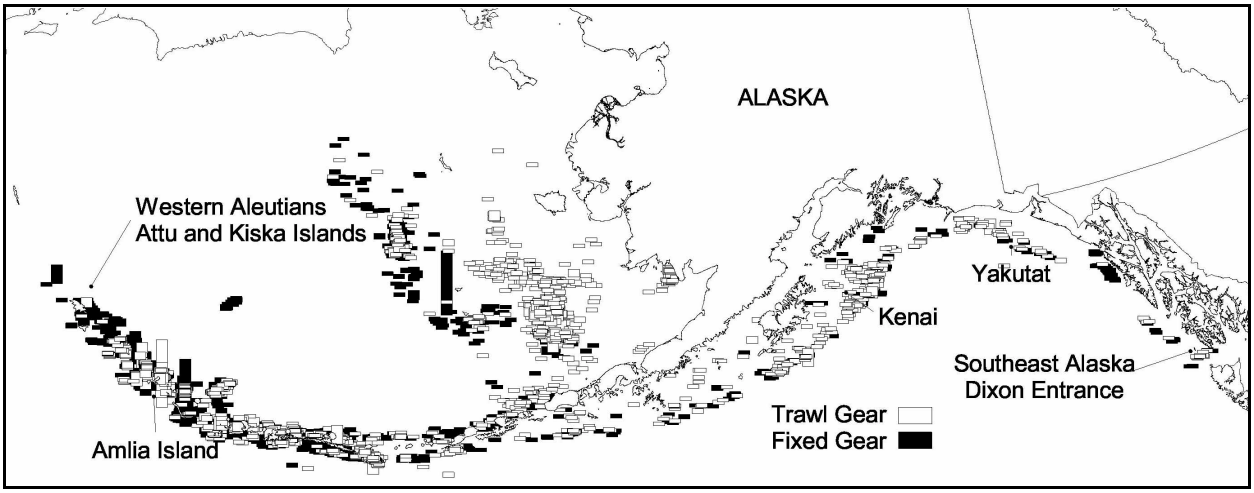

Figure 2. Relative abundance and distribution of all corals and bryozoans based on commercial fishery observer data, 1991-1998.

How does fishing gear effect corals?

Very few studies have been conducted on the effects of fishing gear on deep sea corals. Research has shown that trawl gears can damage sponges and hard corals on tropical shallow water reefs (Tilmant, 1979; van Dolah et al., 1987; Sainsbury et al., 1997), and sponges off Alaska (Freeze et al., 1999). Much less is known about the effects of fishing on deep, cold water corals. Until recently, all that was known for certain was that in areas of fishing, corals had become less abundant (Breeze et al. 1997). In the past couple of years however, biologists have become concerned about fishing impacts on these deep water corals and studies are underway around the world where these corals exist.

Three recent studies have shows that deep water corals are impacted by trawling, even at low intensity. Underwater observations of deep water (200-400 m) Scleractinian coral (*Lophelia* sp.) reefs off Norway have confirmed that trawl gear caused considerable damage (Fossa et al., 1999). A remote operated vehicle, combined with an accurate underwater tracking system, was used to quantify damage caused by shrimp trawls off Australia (Pitcher et al., 1999). They found that about 10% of the fan gorgonians were removed with each pass of the trawl. Krieger (1998) used a

submersible to examine the damage of *Primnoa* caused by a single pass of a research trawl off Dixon Entrance, Alaska, at 365 m depth, made 7 years earlier. The net had removed approximately 1000 kg of *Primnoa*. He observed that about 30% of the coral in the trawl path was removed or broken.

Few observations have been made on the effects of other fishing gear types such as longlines and pots. At a 260 m site off Alaska, rocks and small boulders with attached *Primnoa* and sea annenomes that had been tipped and dragged, probably by longline gear used to fish halibut (*Hippoglossus stenolepis*) and sablefish (*Anoplopoma fimbria*) (Ken Krieger, NMFS, personal communication). High (1998) observed longline gear from a submersible and noted that large branches of corals were snagged by loose groundlines or hooks, and that the hard corals (i.e., *Primnoa* sp.) often had portions broken off. Longlines also catch and retain gorgonians and other corals off Alaska, based on observations from the NMFS sablefish longline survey (Jon Heifetz, NMFS, personal communication), the commercial fisheries observer program, and anecdotal reports from fishermen. Fishermen off Nova Scotia report that longline gear gets tangled up and catches coral when gear is set in areas of coral "trees" (Breeze et al., 1997). The Alaska golden king crab pot fisheries sometimes snag gorgonian corals in the Aleutian Islands area, and observers are now beginning to identify and record these incidental catches (L. Byrne, Alaska Department of Fish and Game, personal communication). An anecdotal report cited in Risk et al. (1998) describes the bycatch of red tree corals entangled in mesh of prawn pots off British Columbia, Canada, and the subsequent disappearance of corals in only six years.

What has been done to date to protect coral off Alaska?

Marine protected areas and catch controls are the two types of management measures have helped to protect deep sea corals from fishing impacts off Alaska. The government bodies established to manage the groundfish fisheries (North Pacific Fishery Management Council and National Marine Fisheries Service) have implemented marine protected areas to protect sensitive bottom habitats and to reduce potential competition of the fisheries with marine mammals (Witherell et al., 2000). In most cases, only mobile gear (trawls, dredges) have been excluded from the marine protected areas.

In 1991, longline fishermen from Sitka and other local citizens proposed that all trawling be prohibited off southeast Alaska. The rationale for this was that trawling was causing long term damage to deep sea corals, causing conservation problems for rockfish, and causing social disruption to the local fishing industry (Behnken, 1993). Although the original proposal was not adopted when brought forth to the Council for final decision, it was later adopted as part of another amendment to the groundfish fishery management plan. Beginning in 1998, all trawling was prohibited in southeast Alaska, a 52,600 nmi^2 area.

A more recent initiative by concerned citizens of Sitka led to establishment of the Sitka Pinnacles Marine Reserve. All bottom fishing gear types (except pelagic troll gear used for salmon) were prohibited in this small 3.1 nmi^2 area. These pinnacles contain high relief habitat, including red tree corals, where lingcod and several species of rockfish aggregated. Increased effort by the charter boat and commercial fleet raised concerns about localized depletion of lingcod and associated habitat impacts (O'Connell et al., 1998). There was strong local support for this reserve as a result of extensive research, underwater video, and public outreach.

In April 2000, the Council adopted a regulation that defines all corals and sponges as prohibited species. The purpose of these amendment was to prohibit a full scale commercial fishery from developing on invertebrates that provide important habitat for fish (NPFMC, 2000). Because the skeleton can be cut and polished to a luster, gorgonian corals had previously been harvested commercially off Alaska and sold for jewelry (Cimberg et al., 1981). The regulation will prohibited the sale, barter, trade of corals and sponges, but allow retention for personal use. Gorgonain corals are

often retained as souvenirs by fishermen when caught incidentally in fisheries off Nova Scotia (Breeze et al., 1997) and off Alaska (Dan Falvey, commercial longline fishermen, personal communication).

What else can we do to protect deep sea corals?

Because gorgonian corals don't move, establishment of a marine reserve or marine protected area in coral "hotspots" seems to be one reasonable management option worth consideration. Marine protected areas have been widely supported in the scientific literature (e.g., Argardy, 1994; Allison et al., 1998; Lauck et al., 1998; Lindeboom, 2000) as a management tool to protect biodiversity, benthic habitats, viable populations, and ecological processes. Marine protected areas implement the precautionary approach by reducing risk and hedging against uncertainties, errors, and biases in fisheries management, thus providing insurance against fishery collapses. In Alaska, marine protected areas have been implemented to prevent damage to vulnerable living substrates caused by trawl gear (Ackley and Witherell, 1999; Witherell et al., 2000). United States President Clinton recently issued an Executive Order to establish a national system of marine protected areas -- known as New Ocean Conservation Zones -- where all fishing,, oil drilling, and other consumptive uses of marine resources are prohibited to preserve marine resources and ensure sustainable economic use of the ocean.

The objective of establishing marine protected areas where gorgonian coral colonies aggregate would be to protect this vulnerable benthic habitat from potential degradation due to fishing, and reap all other benefits provided by such protection. In this particular case, any fishing or non-fishing activity that adversely impacts gorgonian corals should be tightly regulated within these marine protected areas. The most conservative approach would prohibit all bottom fishing gear from the areas, as it is likely that all fishing gear that touches corals would cause some damage. Fisheries using longline, pot, dredge, and trawl gear would be impacted by such action, however, and the social and economic impacts could be significant depending on the size and location of the designated closure areas.

In February 2000, the Council reviewed a bio-economic impact analysis of a proposal to protect gorgonian corals by establishing six marine protected areas, totaling over 7,000 nmi^2. After considerable review and debate, the proposal was tabled for several reasons. First, some fishermen felt that the proposed areas were too large and did not reflect the patchiness of gorgonian coral colonies. Second, quantitative scientific data are limited on coral distribution, so closure areas based on just survey data may divert fishing effort into other areas not currently known to contain corals. Third, many fishermen using longline and pot gear were concerned about being displaced from areas they had previously fished, and many believed that their gear caused less damage to corals than trawl gear. The Council decided that many of these concerns could be addressed by increasing the involvement of coastal community stakeholders in the development of appropriate management measures to protect gorgonian coral colonies.

In this case, the involvement of local community stakeholders, rather than just rely on regional fishing industry spokespersons, is critical. Coastal community stakeholders can provide local and traditional knowledge regarding the abundance and location of benthic habitat types. This information can be extremely useful and valuable in cases where data are limited (e.g., gorgonian corals). Additionally, with increased understanding, stakeholders may take more responsibility for habitat protection and regulatory compliance, thereby reducing the need for enforcement (Lindeboom, 2000). Enforcement has been a major impediment in the effectiveness of marine reserves, particularly when they are small in size or apply to only certain gear types. In the North Pacific region, coastal community stakeholders include not only individuals such as commercial fishers, recreational fishers, and other local people, but also larger groups and coastal businesses involved in fish processing, mining, and dredging, and others.

The stakeholder approach we will be using is based on the focus-group meeting format recommended by Pederson and Hall-Arber (1999) for collecting fish habitat information from fishermen. Our plan is to hold informal meetings in coastal communities to disseminate information, gather local knowledge of coral distribution, build consensus on the need to protect these corals, and develop appropriate management alternatives. We expect this to be a difficult task, but hope that our efforts will provide valuable feedback and insights to protect gorgonian corals from fishing impacts.

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